Headquarters U.S. Air Force

Integrity - Service - Excellence

AF Capability Requirements Driving S&T

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U.S. AIR FORCE

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What We Do As Part of the Joint Team

Global Vigilance, Global Reach, Global Power

Unique responsibilities for political and military leaders and the Nation: Irregular warfare or theater-level engagement – Full Spectrum

- **Survey the planet**
  - From air, space, & cyberspace
  - Detect & analyze enemy activity, capability & intent
- **Range the planet**
  - Threaten & hold those targets at risk, deter & dissuade the enemy
  - Strike, supply, show of force
  - Kinetic / non-kinetic
- **Command & Control our activities**
- **Assess our global effects, across domains**

Fly, Fight and Win as an Integral Part of the Joint Team

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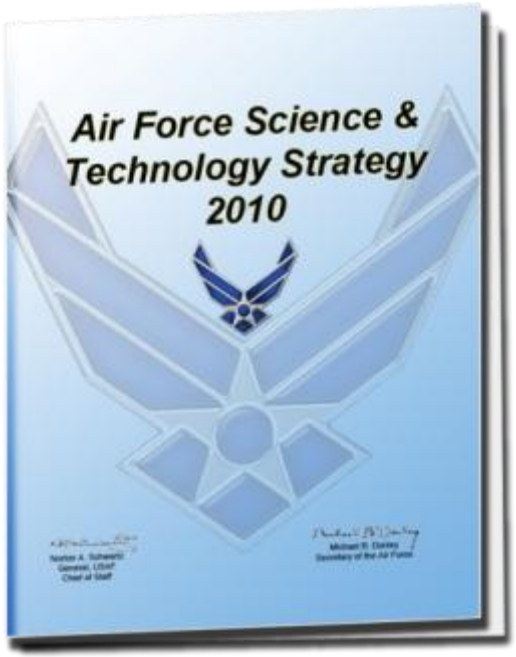
AF S&T Vision

Create compelling air, space, and cyber capabilities for precise and reliable Global Vigilance, Reach and Power for our Nation

Air Force S&T Strategy



- Summarizes S&T vision, tenets and priorities
- Signed by SECAF and CSAF, Dec 2010

AF S&T Program Priorities

1. Support the current fight while advancing breakthrough S&T
2. Execute a balanced, integrated S&T Program
3. Retain / shape the critical competencies
4. Address the highest priority capability needs of the Air Force

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DoD and AF S&T Priorities

SECDEF S&T Priorities	SECAF S&T Priorities
Autonomy *	Develop autonomous systems and human performance augmentation
Human Systems	
EW/EP *	Enable long-range precision strike
Counter A2/AD Capabilities	
Low-cost, Small Footprint Ops	Improve sustainment, affordability, and availability of legacy systems
Engineered Resilient Systems	Reduce energy dependency
Cyber S&T *	Reduce cyber vulnerabilities while emphasizing mission assurance
Data-to-Decisions	Robust SA to enhance decision-makers' understanding -- ISR & PED
Tailored and Adaptive Capabilities	
Integrated Partnership Capabilities	
Counter WMD	Support needs of nuclear enterprise

* AF Lead

Capability Development and S&T Needs

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Service Core Functions

- Space Superiority
- Cyberspace Superiority
- Air Superiority
- Command and Control
- Global Integrated - ISR
- Nuclear Deterrence Ops
- Global Precision Attack
- Special Operations
- Rapid Global Mobility
- Building Partnerships
- Personnel Recovery
- Agile Combat Support

140 Capability Gaps / Req'ts

598 S&T Needs Integration / Prioritization

(Cross-cutting Identification)

15 S&T Priority Areas (Consolidation)

- Advanced Data Processing, Analysis and Management (22)
- Advanced Materials and Structures (8)
- Advanced Navigation (PNT) (19)
- Advanced Sensors (111)
- Advanced Training (5)
- Aerospace Vehicle / Munition Systems (97)
- Autonomy (12)
- Command and Control (38)
- Communication (56)
- Cyber (65)
- Directed Energy (34)
- Electronic Warfare / Electronic Protection (18)
- Energy Efficiency (4)

Execute S&T Efforts that Could Mitigate Identified Capability Gaps

Air Force S&T Planning Process

Identifying Highest Priority Capability Needs

S&T Drivers
NMS, QDR, DPG,
AF Strategy,
Operating Concepts,
CFMPs,
Technology Horizons,
Wargaming

S&T Collaborative Needs/Solutions Process
(MAJCOMs – Centers – AFRL)

Identify S&T Needs & Propose Technology Solutions

MAJCOM S&T Governance

ACC
AMC
AFSOC
AFSPC
AFMC
AFGSC
AETC

AF S&T Group
AF S&T Board
AFROC
VCSAF

Solutions
Responsive to Needs
FCCs
JCTDs
Adv Tech Demos
Hi-Viz S&T Programs
S&T Base Program

- **Core Function Master Plans – AF-level planning**
  - **COCOM needs represented in CFMPs**
- **Capability Collaboration Teams – MAJCOMs, Centers, AFRL**
- **Applied Tech Councils – MAJCOM-level S&T Governance**
- **S&T Group/Board and AFROC – AF-level S&T Governance**

Align Air Force S&T with Air Force and DoD Priorities

Support to New Defense Strategy

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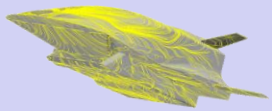
High Speed Strike Weapon

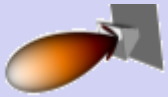


Hypersonic Tech

Supersonic Small Turbine

HIGH-SPEED

CHAMP JCTD



HPM

Laser Technologies

5th Gen Weapons

WEAPONS

Adaptive Engine

F-35 Thermal Mgt

ENERGY EFFICIENT PLATFORMS

EW Plus

EW System of Systems

ELECTRONIC WARFARE

SCOTI Cyber

PCPAD-X

Advanced ISR

Comm & C2

Passive ISR Contested Environ

C4ISR

AUTONOMY

Autonomy

ANGELS

Ground SSA

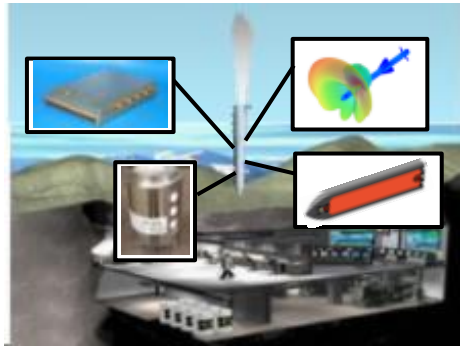
Rad-Hard Electronics

SPACE

Air Force Flagship Capability Concepts

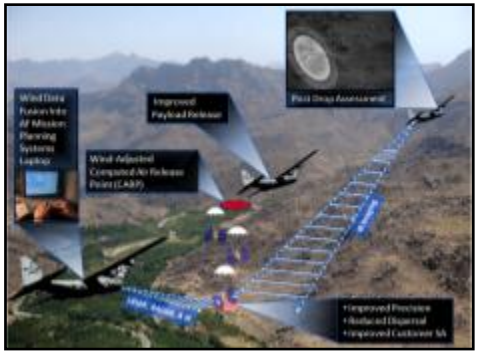
- **AF-level S&T Programs addressing high priority warfighter needs with focus on transitioning capabilities**
  - **High Velocity Penetrating Weapon (HVPW)**
  - **Selective Cyber Operations Tech Integration (SCOTI)**
  - **Precision AirDrop (PAD)**

HDBT and a/c loadout



Mission assurance

Reduce deployment

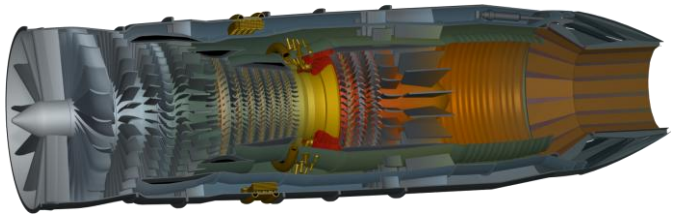


VCSAF APPROVED

Air Force High Visibility Technology Demonstrations

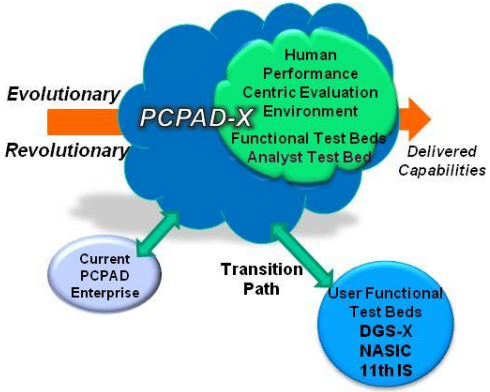
- **AF S&T demonstration programs providing affordable technology options to the warfighter across Services**
  - **Adaptive Engine Technology Development (AETD)**
  - **High Speed Strike Weapon (HSSW)**
  - **Planning, Collecting, Processing, Analysis, Dissemination Experimental(PCPAD-X)**

Energy Efficiency and Performance



Speed, Range, and Survivability

Resolve data/maintain decision making advantage



Balanced capability and affordability across options

Cyber
DoD and AF S&T Priority

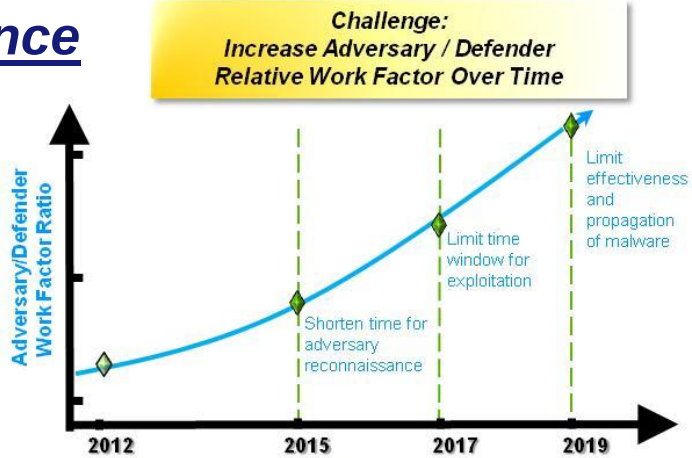
Provide agile cyber operations and resilient infrastructure to assure military missions

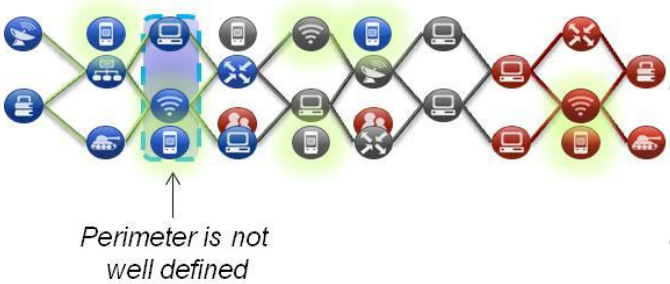
Goal: Mission Assurance

Agile Cyber Operations
Resilient Defenses
Trusted Foundations

Uncertainties

Any element of the cyber infrastructure may be compromised and manipulated; much of which we do not own





Approaches

Cyber & mission situational awareness

Deflect, resist, absorb attacks

Next gen cyber warrior dev

Dynamically changing network architectures to avoid attacks

Trusted design, verification, and fab of ICs; Trusted boot and secure attestation

Kinetic, cyber, and combined missions cyber dependency strengthened

Electronic Warfare
DoD and AF S&T Priority

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Full Spectrum Electronic Warfare Enables Access with Increased Survivability

Goal: Control the EM spectrum during military action

EA/EP
DE

Approaches

Cognitive/Adaptive

Coordinated/Distributed/Network-enabled systems

Preemptive/proactive effects

Broadband/multispectral systems

Open architectures/ Adv EP techniques

Uncertainties

Rapidly evolving capabilities around the world

Enable US Operations in Anti-Access/Access Denied (A2/AD) Environments

Autonomy
DoD and AF S&T Priority

System capability and freedom to self-direct to achieve mission objectives but not necessarily in isolation from humans

Goal: Shared Perception Towards Mission Success

Human – Agent Teaming
Agent – Agent Teaming

Uncertainties

Dynamic and Complex Mission Requirements

Dynamic and Complex Operational Environments

Approaches

Human/Autonomous System Interaction and Collaboration

Scalable Teaming of Autonomous Systems

Machine Reasoning and Intelligence

Testing and Evaluation, Verification and Validation

Autonomous Systems Reduce Friendly Exposure in A2/AD Environments

Planning, Collecting, Processing, Analysis, Dissemination Experimental (PCPAD-X) AF S&T Priority

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Improve ability to process, exploit, and disseminate information

Goal: Enhance analyst performance

Data Analysis

Uncertainties

New data sources and access/volume of data

Holes in data/signature databases

Physical and cognitive variation

Immersive Analyst Environment

Approaches

Data management

Automated tracking and analysis

Increase ability of analyst to manage objects, activities, and events

Automated text analysis

Increase capability of analyst to manage data and information

Affordability and Sustainment AF S&T Priority

Affordability throughout the life cycle a fundamental principle guiding our investment approaches from the outset

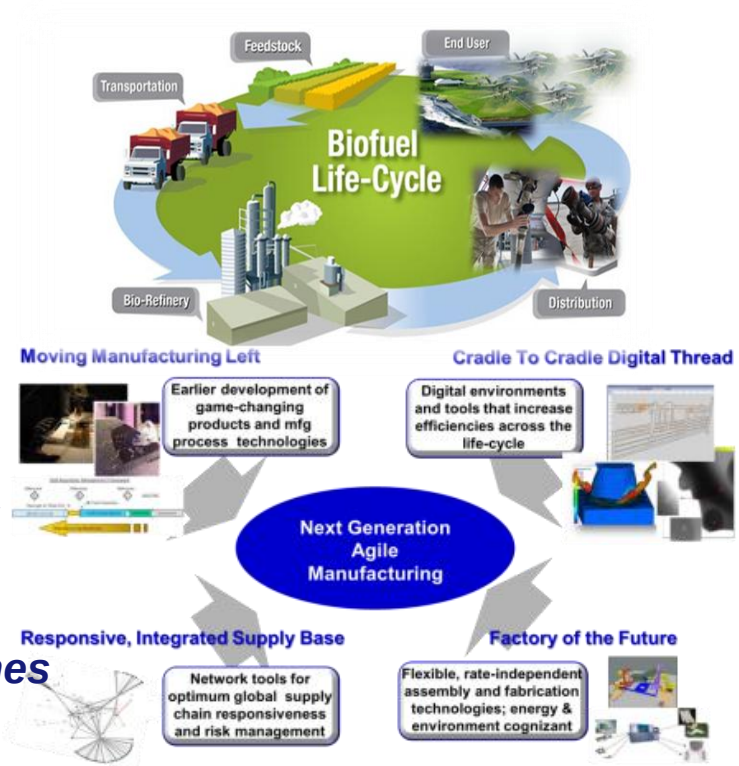
Goal: Reduce cost throughout system

Development costs
O&M costs
Disposal costs

Uncertainties

Costs of new technology difficult to predict

Switching costs and timelines driving mission risks



Approaches

Reduce energy consumption/costs

Apply technology to address legacy fleet sustainment cost drivers

Focus on affordability early in S&T applied research and advanced development

Autonomous Systems Reduce Friendly Exposure in A2/AD Environments

Diversity of AF Basic Research Activities

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Nation is counting on us

Hypersonics Research

Identify, model and exploit critical physical phenomena in turbulent and high-speed flows.

Potential Impact

Enable efficient propulsion and structural systems for long range hypersonic strike in access denied environments.

Funding of world's only quiet hypersonic wind tunnel to examine aerodynamic characteristics of hypersonic vehicle.

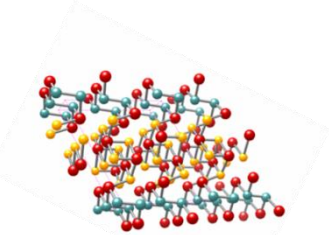
Rest of the world is out in front

Superconductivity

New superconductor with T_c = 23 K found! Explore layered metallic systems for optimal synergy between magnetic, structural & superconducting instabilities.

Potential Impact

Enables compact airborne power generation and gyrotron magnet for airborne high power microwaves.



Naturally occurring sulfur-bearing mineral Canfieldite ($Ag_8(Sn,Ge)S_6$ and related crystallographic structure.

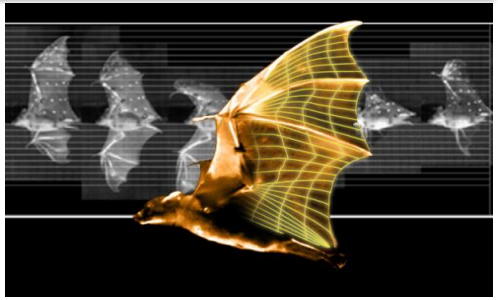
Potential Game Changers

Bio-Sensing of Magnetic Fields

Discover the receptor mechanism(s) for biological magnetic sensitivity, especially at field strengths comparable to the geomagnetic background.

Potential Impact

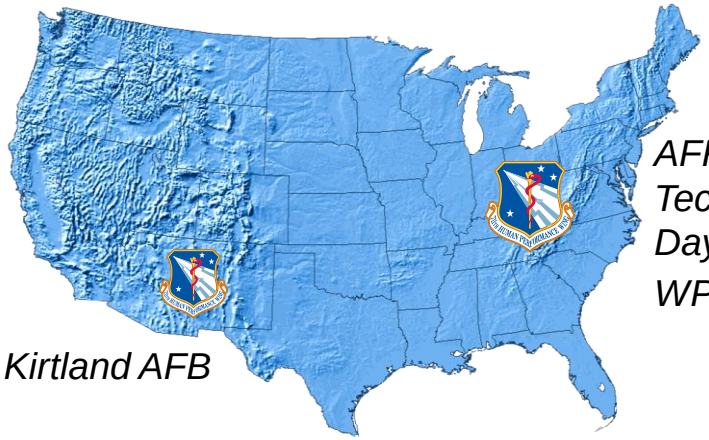
Enable long-range navigation in a GPS denied environment by orientation to the geomagnetic field.



Bio-inspired research to develop multi-agent cooperative systems operating in dynamic, uncertain adversarial

AFRL Technology Days

Populate Defense Marketplace and Dayton Defense websites with data by 1 Jun



Framework: AFRL Focus Areas

Human Performance
Next Gen Aerospace
Affordability & Sustainment
Cyber & Communications
EW/EP
Space & Nuclear
C2 & ISR
Weapons
Basic Research

Venue: Hope Hotel
Date: 23-24 July with potential Industry only on 25 July

Note: Kirtland venue date still in progress

Joint industry/gov't facilitated sessions

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Summary

- Air Force Depends on the S&T Program to discover, develop, and demonstrate high-payoff technologies across all domains – *Tech Push*

- S&T Program Priorities, Program Tenets, and Processes aligned to turn science and knowledge into militarily relevant capabilities – *Tech Pull*

- AF S&T must continue to deliver technology options to the warfighter in the near, mid, and far-term even as opportunities to transition technology are reduced with pressures on the Department's budget

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BACKUPS

Revolutionary Innovation
Technology Push

New Global Horizons Study in Work